

WALK STILLWATER: USING POINT-OF-PROMPT  
SIGNAGE TO INFLUENCE PHYSICAL ACTIVITY IN  
THE DOWNTOWN COMMUNITY

By

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Abstract: Increasing physical activity is crucial to battle sedentary lifestyles, which can lead to numerous health complications. People increasingly rely on the use of vehicular transportation, even at short distances, potentially because the built environment around does not promote physical activity. The built environment can play a crucial role in increasing physical activity in the community. This project implemented and evaluated the Walk Stillwater campaign. The project included installation of point-of-prompt signs in the downtown community of Stillwater, Oklahoma. Point-of-prompt signs represent an environmental cue to action to increase physical activity in a vehicle dependent society. Methods for evaluating this campaign included video recordings of two intervention sites pre- and post-implementation of the program. The primary research question included whether signs increased the proportion of people walking to their destination instead of relying of vehicular transportation. All video recordings were coded by two trained observers. After the installation of the point-of-prompt signs there was no significant change in the number of people walking to their destination at either location. Most individuals continued to rely on vehicular transportation. In addition, no one was observed viewing the signs or scanning the QR codes that would prompt individuals the direction to get to the particular destination. City ordinances may have limited the utility of the point-of-prompt signs by requiring posting at approximately 7 feet, placing the signs at a height that is not easily visible for pedestrians, thereby hindering the intervention.

## TABLE OF CONTENTS

Chapter	Page
I. INTRODUCTION.....	1
Hypothesis I .....	1
Hypothesis II.....	1
II. REVIEW OF LITERATURE.....	5
The Built Environment .....	6
Point-of-Decision Prompts.....	10
Hypothesis I .....	13
Hypothesis II.....	13
III. METHODOLOGY .....	14
Research Design.....	15
Setting and Participants.....	16
Instrumentation .....	16
Procedure .....	18
Data Processing and Analysis.....	18
Ethical Considerations .....	19

Chapter	Page
IV. RESULTS .....	20
Hypothesis I .....	20
Hypothesis II .....	21
QR Scans Community Location .....	22
QR Scans Bus Stop Location .....	22
Sign Views Community Location .....	23
Sign Views Bus Stop Location .....	23
Differently Abled Community Location .....	24
Differently Abled Bus Stop Location .....	24
Post Hoc Analysis – Combine Locations .....	24
Under 18 Combined Location .....	25
Gender Combined Location .....	26
V. DISCUSSION .....	27
Hypotheses .....	27
QR Code Scans at Community and Bus Stop Locations .....	28
Sign Views at Community and Bus Stop Locations .....	29
Differently Abled at Community and Bus Stop Locations .....	29
Limitations .....	31
REFERENCES .....	35
APPENDICES .....	41

## LIST OF TABLES

Table	Page
Table 4.1 .....	21
Table 4.2 .....	22
Table 4.3 .....	22
Table 4.4 .....	23
Table 4.5 .....	23
Table 4.6 .....	24
Table 4.7 .....	25
Table 4.8 .....	25
Table 4.9 .....	26

## LIST OF FIGURES

Figure	Page
2.1.....	7
2.2.....	11
3.1.....	17
6.1.....	44
6.2.....	45
6.3.....	46
6.4.....	47
6.5.....	48
6.6.....	49
6.7.....	50
6.8.....	51
6.9.....	52

## CHAPTER I

### INTRODUCTION

Like many U.S. cities, Stillwater, Oklahoma is part of a larger vehicle dependent society. In 1960, 67% of all trips to work were in a personal vehicle. In 2000, there was a dramatic increase up to 88% of trips to work were by personal vehicle (Brownson, Boehmer, & Luke, 2005). Generally, Americans transportation desires include speed and convenience. Nearly one in five trips in the United States each year are one mile or less, and made in a personal vehicle (Shay, Spoon, Khattak, & Center, 2003). Because of this reliance on personal vehicles, decade old estimates indicate that Americans spend more than one day (26 hours) a year sitting in traffic, an increase of 19 hours since 1982 (Brownson et al., 2005). Compared to active transit, driving a personal vehicle promotes a sedentary lifestyle, which is associated with numerous health complications. Each 60 minutes in a car per day increases the odd of being obese by 6% (Frank, Andresen, & Schmid, 2004).



Caloric imbalance, caused by over nutrition and physical inactivity, is a primary driver of obesity. The American College of Sports Medicine (ACSM) recommends a minimum of 150 minutes a week of moderate physical activity. In Oklahoma, 31.4% of Oklahoma's adult population reported they did not participate in any physical activity at all in the past month (CDC, 2012). Environmental cues, policies, and programs to promote physical activity are needed.

Walking is a low-impact activity that most people can perform. Due to its documented health benefits and accessibility, walking has the potential to have a substantial public health impact, particularly among those who do not currently engage in physical activity (Lee & Buchner, 2008). Individuals who are sedentary and deconditioned may experience health benefits from engaging in physical activity at levels that do not meet the ACSM requirements (Institute of Medicine, 2013).

The Walk Stillwater program consisted of point-of-decision signs throughout the downtown Stillwater, Oklahoma to inform people the time it takes to get to popular local destinations within the community via walking and biking. The signs are color-coded: green signs for public spaces, and orange signs for community attractions, i.e., a college football stadium. Each sign included a QR code which links to a website with directions to the destination.

Ecological models of health behavior provide a comprehensive framework the multiple determinants to health behavior (Sallis, Owen, & Fisher, 2008). Healthy behaviors are amplified when policy and the environment support healthy choices (Sallis et al., 2008). The built environment plays a crucial role in physical activity. The signs

represented an environmental cue to action to increase physical activity in a vehicle-dependent society.

The evaluation of the Walk Stillwater point-of-prompt signs used an observational design to identify changes in physical activity levels in two locations in the downtown community: one location is adjacent to a bus stop where Oklahoma State University transports people to the university football stadium on game days (bus stop location), and the other location was next to local retail shops (community location). Observations were completed using a GoPro Hero 4 camera mounted within a personal vehicle and pointed toward the future sign location. Observations were completed at each location prior to installation of signs and following sign installation. Observations of the bus stop location were approximately two hours long, occurring immediately prior to game time, and the video at the community location was approximately 2.5 hours in length. The post-tests were recorded one week after the installation of the signs. Coding was completed by two trained observers on how to accurately code each specific observation. After the coding was completed, data was analyzed with an additional coder to achieve 100% inter-reliability. This design allows us to address two primary hypotheses:

**Hypothesis 1:** The proportion of walkers will increase on streets frequented by individuals from the community after the installation of the signs compared to before the signs were installed.

**Hypothesis 2:** The proportion of walkers will increase after the signs have been installed compared to before the installation of the signs on game days at the location where individuals park personal vehicles and wait for transit shuttle to the game experience.

## CHAPTER II

### LITERATURE REVIEW

In Oklahoma, 66.3% of the adult population is overweight, with a Body Mass Index (BMI) that exceeds 25 or greater. Nearly half of (45.8%) of overweight individuals, reflective of nearly one-third (30.4%) of the general population, are considered obese, with a BMI that is 30 or greater (CDC, 2012). Oklahoma is one of nineteen states that their prevalence of obesity is between 30% and <35% (CDC, 2015).

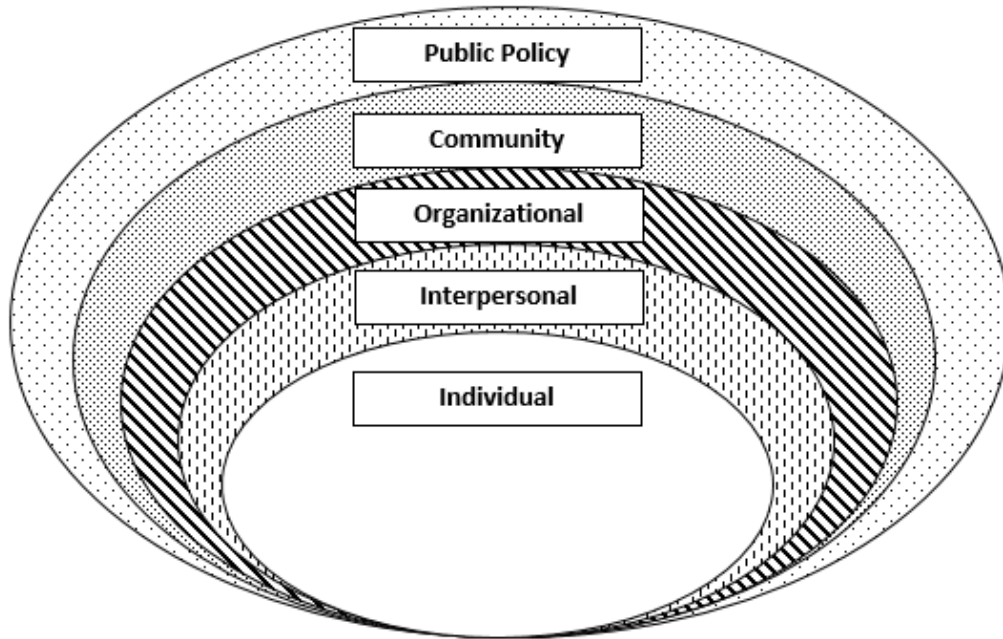
Regular physical activity can decrease the risk of cardiovascular disease, obesity, cancer, type 2 diabetes, osteoporosis, increase mood, and combined with balanced diet regular and physical activity can help people maintain a healthy weight. Beneficial effects of regular physical activity are well known. And yet, population level estimates of physical activity continue to decline over time. Nearly a third (31.4%) of Oklahoma's adult population did not participate in any physical activity during the past month (CDC, 2012).

Moreover, only 41.5% of Oklahoman adults met recommended guidelines of at least 300 minutes of moderate-intensity aerobic physical activity a week or 150 minutes of vigorous physical activity (CDC, 2012). One reason for the reduction in regular physical activity is the increases use of personal vehicles. Driving is an inherently inactive behavior, requiring potentially long hours in a sitting position. Time spent in a personal vehicle as a driver or passenger is positively associated with being obese: each additional hour spent driving increases the odds of being obese by 6% (Frank et al., 2004). Personal vehicles are the standard for transportation in most developed countries (Rajan, 1996). Nearly 25% of all personal trips in the United States each year are less one mile or less, yet close to 75% of these trips are still made in a personal vehicle (Shay et al., 2003). Over time, as the number of drivers has increased, municipalities and states have invested in infrastructure, or the built environment, to support transportation via personal vehicle. These changes in the infrastructure may also de-emphasize infrastructure for walking or other physically active transport. Living in an environment built for personal vehicles may negatively impact ability to engage in active transport. In the United States, only 28.2% of adults walked for transportation in intervals of at least 10 minutes. In comparison, 41.5% of adults walked for leisure (Kruger, Ham, Berrigan, & Ballard-Barbash, 2008).

### **The Built Environment**

The built environment can both facilitate and hinder physical activity (Booth, Pinkston, & Poston, 2005). For example, areas with few recreational facilities, inadequate sidewalks, insufficient lighting, safety concerns, and terrain issues all play a role in physical activity (Booth et al., 2005). There are multiple levels of factors influence

health behaviors (Sallis et al., 2008). Identifying opportunities to promote and encourage physical activity in the built environment may be necessary to combat epidemics related to physical inactivity. One way to facilitate change, and promote physical activity, is through installation of signage that prompts physical activity through active transit.



**Figure 2.1: Social-Ecological Model of Health Behavior**

Figure 2.1 represents the Social-Ecological model of health behavior (Stokols, 1996). The Social-Ecological model emphasizes the organizational, communal, and public policy contexts of behavior, while incorporating interpersonal and individual influences. Ecological models lead to the accurate consideration of multiple levels of influence, guiding the development of more comprehensive interventions (Sallis et al., 2008). In Figure 2.1 the public policy level focuses on local, state, and national policies and laws. The Walk Stillwater campaign needed to collaborate with the City of Stillwater to get approval for the signage to be installed in a public location. The community level

of the model includes family, informal social networks, churches, schools, voluntary associations, and neighborhoods that may be crucial sources of social identity and social resources of the community (McLeroy, Bibeau, Steckler, & Glanz, 1988). The signs in this level create a public awareness of physical activity within the Stillwater, Oklahoma create a cue to action to help influence people to engage in active transportation. The interpersonal level is the individual's ongoing support from their family, friends, and small groups (Sallis et al., 2008). Social relationships are influential sources in health related behavior. They provide emotional support, information, social relationships, and assistant in fulfilling social and personal responsibilities obligations (McLeroy et al., 1988). The Walk Stillwater campaign prompts that support. If someone from a group of people saw the signs they may encourage others in their groups to use physically active transportation.

Lastly, the individual level of the Social-Ecological model of health behavior describes the individual characteristics that influence behavior such as attitudes, beliefs, knowledge, and personality traits (Gregson et al., 2001). Health Belief Model is one individual-level behavior change theory appropriate for increasing one-time behaviors (McLeroy et al., 1988). In addition to cues to action, the Health Belief Model has four dimensions: perceived susceptibility, perceived severity, perceived benefits, and perceived barriers (Janz & Becker, 1984). The Walk Stillwater campaign uses a single construct from the Health Belief Model: cues to action to remind people to engage in a healthy behavior (Champion & Skinner, 2008). These cues are stimulus needed to trigger the decision-making process to accept a recommended health action. The goal of the prompts is to encourage individuals to be physically active.

The promotion and adherence to physical activity is a public health priority. Cues to action and changes in the infrastructure are crucial. Walking to work is positively associated with: number of destinations, variety of destinations, inclusive of pedestrians, exclusive of pedestrians, social dynamics, walking routes, meet pedestrian's needs, walking system, transportation system, complexity of stimulus, potential "overload" of stimulus, time and effort required, traffic threats, obstacles, safety from crime, and potential for crime (Craig, Brownson, Cragg, & Dunn, 2002). Individuals living in areas of low-traffic neighborhoods were more likely to meet the recommendations for leisure activity compared to those living in high-traffic areas (McGinn, Evenson, Herring, Huston, & Rodriguez, 2007). There has been an increased public awareness of the benefits of non-motorized travel. Installing the signs may serve as an environmental cue to action to help increase physical activity in a vehicle dependent society.

Community trail development has been used as an emerging strategy to increase the physical activity levels among residents of a community. Designated trails for walking are beneficial in promoting physical activity. Notably, 55.2% of people who used the community trail increased walking after the trails opened. This phenomenon was measured in six communities in Missouri, Tennessee and Arkansas that focused on adults that were 18 years of age or older. Nearly one in three (32.1%) residents reported an increase in their physical activity levels since they began to using trail (R. C. Brownson et al., 2000). A combination of infrastructure and signage is helpful for increasing physical activity in the context of community trails.



## **Point-of-Decision Prompts**

Point-of-decision prompts serve as an environmental cue to action for physical activity (Rosenstock, Strecher, & Becker, 1988). Point of decision prompts have been successfully implemented to increase foot traffic in areas of public transportation. In one large metropolitan airport, point-of-decision prompts increased foot traffic by 14% (Fulton, 2015). In Berlin, Germany point-of-decision prompts were used to encourage stair use in three busy underground train stations. The posters were fastened at the bottom of each stairwell and encouraged people to take the stairs instead of the adjacent escalators. Before the posters were hung 18.9% of women used the stairs. After the posters were hung the percent of women who took the stairs increased significantly to 31.9%. The amount of men who took the stairs after the posters were hung was not significant (Müller-Riemenschneider, Nocon, Reinhold, & Willich, 2010).

Verbal point-of-decision prompts at the start and the middle of an academic presentation encouraged standing. The researchers observed the audience at three distance time points during the presentation: start (first 10 minutes), middle (30-40 minutes), and at the end (50-60 minutes). In total, 10.5% of attendees chose to stand during sessions that did not include the prompt, whereas 16.9% stood when exposed to the prompt (Lang, McNeil, Tremblay, & Saunders, 2015). The results proved that the use point-of-decision prompts to be effective. It was observed that a significantly large proportion of individual chose to stand during the presentation.

Point-of-decision signage can also be a form of tactical urbanism. These types of projects are generally short-term, community-based and can range from pop-up parks to street initiatives (Lydon & Garcia, 2015). One example of this happened in Raleigh,

North Carolina with a similar initiative as the Walk Stillwater campaign. The Walk Raleigh project began with an overnight installation of 27 unsanctioned signs to promote physical activity. The signs were basic, including an arrow, QR code, color coded, and how long it took to walk a given destination in minutes. “It’s an 18-minute walk to Glenwood South,” read one sign in purple. “It’s a 7-minute walk to Raleigh City Cemetery,” read another sign in green. (Waggoner, 2012). The creator, Matt Tomasulo, a Masters student in Community and Regional Planning at the University of North Carolina, created the signs to elucidate the idea that walking is not time consuming.



**Figure 2.2: Walk Raleigh Project**

The signs violated city laws and were swiftly removed. However, within three days the city received 1,255 digital signatures asking for the signs to be erected again. In fact, the Planning Director for the city was very vocal about the signs and they were resurrected in the form of a 90-day city pilot project (Benner, 2013). People wanted the

signs as a permanent fixture in the community were willing to fight for them. The awareness for the project showed how much value people put in being physically active and that they were being used in the community.

Another example of how tactical urbanism caught people's attention and support happened in San Francisco, California in 2005 when the company Rebar decided to approach on-street parking in an innovative way. The company decided to interpret metered parking as a "short-term" lease rather than a typical parking spot. The innovators paid for the meter for two hours and unrolled sod, set down potted plants, and placed a bench in the spot. They developed a temporary park for people to enjoy right in the middle of the city. By reinterpreting a public place that is designed to accommodate a personal vehicle within the community, they challenged the city's priorities and gave people the green space and invited people to enjoy, and to feed the meter while they passed by (Waggoner, 2012). The project ended up bringing them acclaim and cities across the nation started replicating the idea.

The Walk Stillwater Campaign took place in downtown area of the community. This area was established in 2007 and funded through annual assessments. Downtown Stillwater is a formal organization of commercial tenants and property owners with support from the City of Stillwater dedicated to economic cultural growth, development and a commitment to create a welcoming environment for all who live, work, play and dine in the area. The Walk Stillwater campaign may prompt physical activity. This study was designed to evaluate the campaign and answer the following hypotheses:

**Hypothesis 1:** The proportion of walkers will increase on streets frequented by individuals from the community after the installation of the signs compared to before the signs were installed.

**Hypothesis 2:** The proportion of walkers will increase after the signs have been installed compared to before the installation of the signs on game days at the location where individuals park personal vehicles and wait for transit shuttle to the game experience.

## CHAPTER III

### METHODOLOGY

Although not a key part of the evaluation, the Walk Stillwater program was a collaboration with the City of Stillwater that created environmental cues to action with a goal of increasing physically active transport in an environment created for vehicular transit. Brief details of the Walk Stillwater collaboration include initial meetings with the Director of Operations of Stillwater. Upon the approval of the project from the City of Stillwater, an additional meeting was scheduled with the Business Improvement District Coordinator to establish the destinations signs would prompt people to. Once these specific locations were determined, the City of Stillwater identified the proper locations for where the built environment was supportive and did not require the removal of existing infrastructure. The locations were decided upon by the City of Stillwater to help raise awareness to local community destinations. The signs were placed at 7<sup>th</sup> and Lewis, 10<sup>th</sup> and Main, 8<sup>th</sup> and Main, and Boomer Lake.

City of Stillwater requested the signs directed people to The Sheerar Museum, Stillwater Public Library, Boone Pickens Stadium, Stillwater Community Center, Boomer Lake, Southern Woods Park, OSU Museum of Art, and Downtown Stillwater. The City of Stillwater agreed to fund the labor costs for the installation of the signs and Oklahoma State University Department of Nutritional Sciences agreed to pay for the materials of the signs.

### **Research Design**

An observational study was used to evaluate the Walk Stillwater campaign. The evaluation of this study used two of the four locations: 7<sup>th</sup> and Lewis location (bus stop) and 8<sup>th</sup> and Main (community). Both evaluation locations are near local restaurants, shops, and amenities. A GoPro Hero 4 camera was placed in a parked car, on the dash, and pointed toward the bus stop and community locations for 2 to 2.5 hour before and after sign installation.

The set of observations at the community location included largely local or a community-based demographic. Observations covered 2.5 hours of time. The set of observations at bus stop was where the free shuttle picked-up people for Oklahoma State football games and ran for approximately two hours. These observations at the bus stop location likely included individuals who do not currently reside in Stillwater, although we anticipated that some members of the local community also used the shuttle from downtown to the football games. These observations occurred before and after sign installation before two home football games. After the data was collected, the recordings were coded and inter-rater reliability was calculated. Comparisons between pre-test and post-test was evaluated by a chi square test for each observation location. The results

were then extrapolated to see if there were significant changes in the proportion of people who engaged in physically active transportation after the signs were installed.

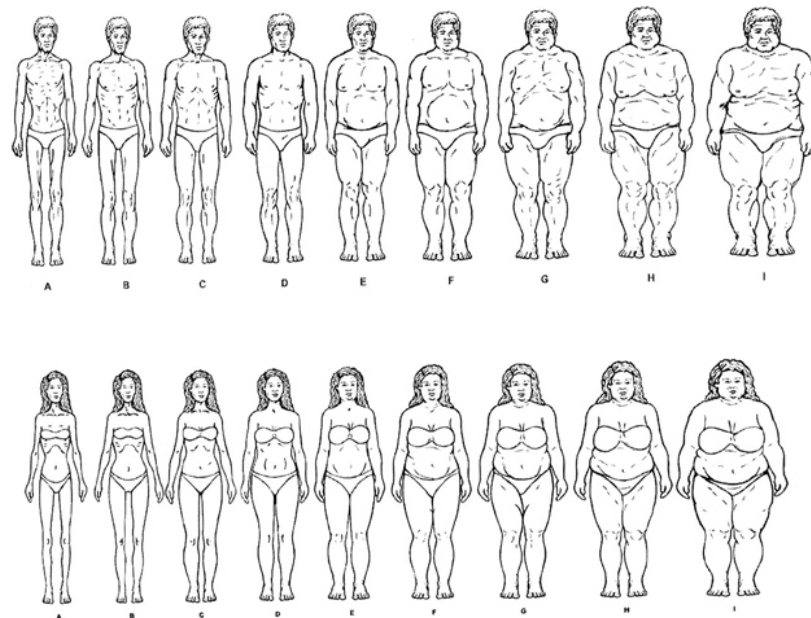
### **Setting and Participants**

The first location was on 7th avenue East and Lewis (bus stop). This is where the OSU Park & Ride Shuttle provided no-cost transportation to individuals to OSU home football games. The location of these signs were chosen due to the increased likelihood of people being in the area. The second location where the camera was between 8th avenue East and Main (community location). These locations were chosen due to existing structure, prevalence, and recommendations from the city. The bus stop location sign gave the time in minutes to Boone Pickens Stadium and provided them with a safe walking route if they scanned the code with their smart device. In addition, the community location gave the time in minutes to the Community Center and the OSU Museum of Art if they scanned the code it would provide them with a safe walking route. The study aimed to engage people who lived in Stillwater, Oklahoma and people outside of the community.

### **Instrumentation**

Observational data were recorded using a GoPro Hero 4 camera. After the video was recorded, the data was transferred to a secured external hard-drive. An excel spread sheet was used to code the video to allow a proper transition into a data analytical tool. Variables that were observed included: time stamp, gender, visibly under 18, visibly differently abled, weight status (normal or overweight/obese), walk, and QR scans. Time stamp referred the running time when the observation was made. For gender, this was

recorded as male or female if it was able to be determined. If it could not be determined, it was recorded as NA. We did not code individuals as under 18 unless they were with a guardian and resembled a minor in height. In addition, people were not coded as differently abled unless they needed physical assistance (i.e. walker, wheelchair, or support from another person). Weight status coding was conservative in nature: people were not coded as overweight/obese unless they were a 'G,' 'H,' or 'I' for both male and female from the chart taken from the research journal 'Obesity' (Pulvers et al., 2004). Finally, people were recorded as walking if they crossed the intervention site and continued to walk. The video was segmented every 17:42 minutes due to how GoPro uploads the videos into individual files at this length. This was due to how GoPro files each individual portion of the videos.



**Figure 3.1: Body Composition Chart**



## **Procedure**

The PI and an additional colleague coded the data to increase the validity. In addition, the timeline for the collection of the data was identical. For example, the pre-test took place at bus stop on Saturday, November 21<sup>th</sup>, 2015 from 3:30-6:00 p.m. The post-test took place on Saturday, November 28<sup>st</sup>, 2015 from 4:00-6:30 p.m., after the installation of the signs. The video was recorded approximately 2 hours prior to the start of the game. At the community location, the pre-test took place on Sunday, November 22<sup>nd</sup> from 4:00 PM - 6:30 PM and the post-test took place on Sunday, November, 29<sup>th</sup> from 4:00 PM – 6:30 PM. After the completion of the post-tests we coded the data separately and then checked for the interrater-reliability between each of the data sets.

## **Data Processing and Analysis**

For data processing and analysis the video was coded and reviewed by two people: the PI and an additional coder. The additional coder was given precise information on how to code the data to ensure both of the observers were using identical coding protocols. After initial coding of the data was complete, an initial reliability analysis has a 70% inter-rater reliability. Next, the data was evaluated to find any differences in coding. Both observers worked together on to view and discuss discrepancies in coding. Although it wasn't necessary, if an observation could not be agreed upon, a neutral third person would have made the final decision. After the completion of the discussion of the findings a 100% agreement was achieved by correcting gender codes and missed people.

## **Ethical Considerations**

All research done for the Walk Stillwater campaign was of high quality and integrity. After the videos were coded and discussed by the PI and coder they were deleted. By deleting the recordings, all subjects remain anonymous. In addition, no harm happened to anyone involved in the study. Finally, the research was independent and impartial.

## CHAPTER IV

### RESULTS

In total, data were coded for 860 pedestrians across both of the locations for the pre and post-tests. Of these, 239 were males, 93 were females, and 538 of unknown gender due to difficulties coding gender because of weather, lighting, and camera placement.

**Hypothesis 1:** The proportion of walkers will increase on streets frequented by individuals from the community after the installation of the signs compared to before the signs were installed.

There was no observed increase in the proportion of walkers at the community location following in the installation of the signs than before the signs were installed. A total of 860 people were observed in the study between both locations, with 4.53% (39) of the people were observed at the community location across the pre and post-test. At

the community location 38 people were observed walking and one person was observed using a wheelchair.

A relatively similar number of individuals were observed walking at pre-test (n=21) and at post-test (n=18). Chi-square analysis was not significant, suggesting that groups are not significantly different; however, because only one person was observed not walking, there is inadequate cell size for this statistic ( $\chi^2 = 0.88$ ,  $p=0.35$ ).

**Table 4.1: Walking observed in the Community**

	<b>% Yes (n)</b>	<b>% No (n)</b>	<b><math>\chi^2</math></b>	<b>P-value</b>
Pre-Test	95.2% (20)	4.8% (1)	0.88	0.35
Post-Test	100% (18)	0% (0)		

**Hypothesis 2:** The proportion of walkers will increase after the signs have been installed compared to before the installation of the signs on game days at the location where individuals park personal vehicles and wait for transit shuttle to the game experience.

There was no observed increase in the proportion of walkers at the bus stop location following in the installation of the signs. Of the 860 people observed in the study, 95.4% (821) people were observed at the bus stop location across the pre and post-test. All of these individuals were observed to not be walking. A similar number of individuals were observed not walking at pre-test (n=410) and at post-test (n=411). Due to inadequate cell size, a Chi-square analysis was not conducted.

**Table 4.2: Walking observed at the Bus Stop**

	<b>% Yes (n)</b>	<b>% No (n)</b>	<b><math>\chi^2</math></b>	<b>P-value</b>
Pre-Test	0% (20)	100% (410)	-	-
Post-Test	0% (18)	100% (411)		

### **Post Hoc Analysis**

#### **QR Code Scans – Community Location**

QR Codes scans were coded to see if anyone would scan the QR code to bring up the directions to the location after the signs were installed. At the community location there was no recorded scans during the post-test (n=18), and due to inadequate cell size, a Chi-square analysis was not conducted.

**Table 4.3: QR Code Scans observed in the Community**

<b>QR Code Scans</b>	<b>% Yes (n)</b>	<b>% No (n)</b>	<b><math>\chi^2</math></b>	<b>P-value</b>
Post-Test	0% (0)	100% (18)	-	-

#### **QR Code Scans – Bus Stop Location**

QR codes scans were also coded during the post test at the bus stop location. This location had a significantly larger sample size (n=411). While there was a larger sample size, no one was observed to scan the QR code and due to inadequate cell size, a Chi-square analysis was not conducted.

**Table 4.4: QR Code Scans at the Bus Stop**

QR Code Scans	% Yes (n)	% No (n)	$\chi^2$	P-value
Post-Test	0% (0)	100% (411)	-	-

**Sign Views – Community Location**

Although there were no observed changes in the proportion of people walking, a post hoc analysis was conducted to see if anyone viewed the signs. No individuals were observed viewing the sign during post-test (n=39) and due to inadequate cell size, a Chi-square analysis was not conducted.

**Table 4.5: Sign Views observed in the Community**

QR Code Scans	% Yes (n)	% No (n)	$\chi^2$	P-value
Post-Test	0% (0)	100% (18)	-	-

**Sign Views – Bus Stop Location**

Sign views were also observed at the bus stop location. Similar to the community location, no one viewed the signs during the post-test (n=411). Since there was inadequate cell size, a Chi-square analysis was not conducted.

**Table 4.6: Sign Views observed at the Bus Stop**

<b>QR Code Scans</b>	<b>% Yes (n)</b>	<b>% No (n)</b>	<b><math>\chi^2</math></b>	<b>P-value</b>
Post-Test	0% (0)	100% (411)	-	-

**Differently Abled – Community Location**

Differently-abled was also assessed to see if physical limitations had any impact on the results of the intervention. During the pre-test (n=21), we observed one individual in a wheelchair. The post-test has a relatively similar sample size (n=18), but no one was found to have any physical limitations.

**Differently Abled – Bus Stop Location**

The same observations were made at the bus stop location to see if people being differently-abled had any significance. During the pre-test (n=410), no one had a physical limitation that would limit their walk without assistance. The post-test (n=411) had one individual observed as being differently abled. In total, over 99% of the population during the post-test was able to walk without assistance.

**Post-Hoc Analyses – Combined Locations**

In order to better understand the null-results of the initial analyses, three post-hoc analyses was conducted. The first post-hoc analysis was conducted to assess observed weight status and walking across the locations: individuals with a weight status coded as overweight/obese were more likely to walk to their destination than individuals of normal weight ( $\chi^2 = 5.86, p=0.015$ ). This p-value is statistically significant, using a Bonferroni adjusted p-value for the 3 post-hoc analyses.



**Table 4.7: Weight status and Walking – Combined Locations/Tests**

Weight status	Walk		$\chi^2$	P-value
	% Yes (n)	% No (n)		
Overweight/Obese	10.45% (7)	86.55% (60)	5.868	0.015
Normal	4.03% (32)	95.97% (761)		

### Under 18 – Combined Locations

A second post-hoc analysis was conducted to assess observed whether having a child was related to walking across the locations ( $\chi^2 = 0.10$ ,  $p=0.919$ ). There was no difference between these groups.

**Table 4.8: Under 18 and Walking – Combined Locations/Tests**

Under 18	Walk		$\chi^2$	P-value
	% Yes (n)	% No (n)		
Yes	5.0% (1)	95.0% (19)	.010	.919
No	4.52% (38)	95.48% (802)		

### Gender – Combined Locations

A third and final post-hoc analysis was conducted to assess gender and walking across the locations: females were significantly more likely to walk to their destination than males ( $\chi^2 = 30.46$ ,  $p \leq 0.001$ ).

**Table 4.9: Gender and Walking – Combined Locations/Tests**

Gender	Walk		$\chi^2$	P-value
	% Yes (n)	% No (n)		
Male	5.24% (12)	94.76% (217)	30.458	0.000
Female	26.9% (25)	73.1% (68)		

## CHAPTER V

### DISCUSSION

#### **Hypotheses**

The Walk Stillwater produced no significant results at neither the bus stop location nor the community location for people observed to be walking after the installation of the signs. In total, 860 people were observed across the study. None were seen to walk after the installation of the signs at the bus stop location. At the community location, however, there were not a sufficient number of individuals walking to achieve statistical significance. Moreover, it is not possible to determine if individuals were walking for physical activity or to reach their personal vehicle. People in the United States are very dependent on vehicular transportation, even when traveling short distances. The locations observed within the present study included signs to points of interest that were within walking distance.

In the United States, nearly a quarter of all personal trips taken year are one mile or less, yet nearly 75% of these short trips are made in a personal vehicle (Shay et al., 2003). Due to the habitual nature of these trips, presence of signs to increase physical activity may be inadequate to overcome habitual behaviors and the larger built environment.

The level of people using their vehicle such short distances can have impact on the physical activity levels of people in the United States. In Oklahoma, nearly a third (31.4%) of Oklahoma's adult population reported that they did not participate in any physical activity during the past month (CDC, 2012). Only 41.5% of Oklahoman adults met minimal standards of at least 300 minutes of moderate-intensity aerobic physical activity a week or 150 minutes of vigorous physical activity (CDC, 2012).

### **QR Code Scans at the Community and Bus Stop Locations**

Across the study there was no one observed to scan the QR code on the signs that would give people the directions to the destinations. These codes are a type of matrix bar code or two-dimensional code designed to be read by smartphones (Rouillard, 2008). The bus stop location QR code would bring up a map to Boone Pickens Stadium and provide them with a safe walking route if they scanned the code with their smart device. In addition, the community location QR would prompt users to Community Center and the OSU Museum of Art if they scanned the code. In addition, going through the online portal that tracks total QR code scans it was found that no one had scanned the code since the installation of the signs at all locations. However, they have an obvious weakness: the reality of sparse interaction since they require that they be accessed via smartphones

(Dou & Li, 2008). Another possible reason for the lack of scans was the height the city installed the signs. At that distance, it would be difficult for many people to be able to scan the code effectively.

### **Sign Views – Community Location and Bus Stop Location.**

It was observed that no one viewed the signs at either the bus stop or the community location. This result was surprisingly different from a similar study that was done in Raleigh, North Carolina where they project began with an overnight installation of 27 unsanctioned signs to promote physical activity. Although were swiftly removed since they violated city law, within three days the city received 1,255 digital signatures asking for the signs to be erected again. In fact, the Planning Director for the city was very vocal about the signs and they were resurrected in the form of a 90-day city pilot project (Benner, 2013). This shows the population viewed the signs and found them as a valuable part of their built environment. Since no one viewed the signs throughout the study it could be suggested that they have no outcome on people choosing to walk over vehicular transportation.

### **Differently Abled – Community Location and Bus Stop Location**

It is believed that people with a disability can also benefit from a physically active lifestyle (van der Ploeg, van der Beek, van der Woude, & van Mechelen, 2004). The Walk Stillwater campaign has a limited number of individuals who were observed to be differently abled (n=2). Of these two individuals, one had a walker and the other was in a wheelchair. Since there was a minimal number of people who fit this criteria, it has no significant result on the outcome of either hypothesis. It is important note that this

campaign would present difficulties for people who do have a disability since the walking time in minutes would likely increase in duration and could provide a challenge for them to engage in the intervention to promote active transportation. However, secondary health and functioning problems in people with a disability could be prevented or reduced by a physically active lifestyle are numerous (van der Ploeg et al., 2004).

Group transportation with and without children was not significantly different. The insignificant number of minors walking correlated with the adult population since adolescents were only recorded when they were observed with their parent or guardian. If the parents chose not to walk, the minor would do the same. During childhood and adolescence, families play a crucial role in influencing their children's health behaviors including physical activity (Ornelas, Perreira, & Ayala, 2007). Parents model behaviors for their children, engage in activities with them, monitor their children's behaviors, and provide support and encouragement that can result in behavior change and positive health outcomes (Ornelas et al., 2007). In primary school-aged children, walking to school is associated with higher levels of physical activity compared with those who travel to school by vehicular transport. Most (>85%) of the children traveling on foot, or via bicycle or vehicular transport had a journey time of  $\leq 15$  minutes (Cooper, Andersen, Wedderkopp, Page, & Froberg, 2005). It is imperative that adults model healthy behavior for their children to establish healthy behaviors for the future.

Lastly, gender across both location across the population was studied to see if there that played a role if people engaged in walking to their destination or if they chose to use vehicular transportation. Across both the pre and post-test it was shown that women were significantly more likely to engage in walking. This phenomena also was

shown in Berlin, Germany where point-of-decision prompts were used to encourage stair use in three busy underground train station where posters were fastened at the bottom of each stairwell and encouraged people to take the stairs instead of the adjacent escalators. Before the posters were hung 18.9% of women used the stairs. After the posters were hung the percent of women who took the stairs increased significantly to 31.9%. The male population did not have significant results. The Walk Stillwater study has more males that were observed across the study since the bus stop location. If females are more likely to engage in physical active transport it would be beneficial to install the signs in a more gender friendly areas (Müller-Riemenschneider et al., 2010).

### **Limitations**

One issue with the intervention is that no one was seen to have viewed the signs. The signs measured at 12"x12" which could have made it difficult for people to notice the signage. In addition, the signs during this study were installed at 7' feet due to city ordinance. It would be recommended in future studies using point-of-prompt signs as a cue to action that they are installed at eye level so people who are observing the signs will be more likely to see them.

Although we observed that no one scanned the signs it should be noted that this technology has been used in a previous study with success. Since August 2014, students in Danish public schools are required to achieve 45 minutes of physical activity per day. In the study, three lessons were taught using QR codes and three lessons were taught using a traditional approach. It was observed that student were significantly more active in the lessons taught using the technology compared to not (Christensen, Kristensen, &

Bredahl, 2015). In addition, an exploratory study was done the examined three different, but demographically similar high schools using Twitter, Facebook, and QR codes as recruitment channels for online health research. The results of the study showed that greatest response rate across the three platforms and can be a tangible recruitment method to recruit adolescents for online health research (Gu, Skierkowski, Florin, Friend, & Yi, 2016). In addition, an exploratory survey was issued in 2014 concluded that consumers liked using QR codes and would continue to use the in the future since they had favorable feelings towards the speed of the information offered by using QR codes and the convenience (Ertekin & Pelton, 2015).

Weather was also limitation for the study that may have changed people's intentions to take vehicular transportation instead of walking. During the pre-test November 21<sup>st</sup>, 2015 the weather was recorded to be 49 degrees in which was a 20-degree temperature change from the previous day. It being colder than normal, could have caused people to take transit transportation instead of walking. The pre-test done on Sunday, November 22<sup>nd</sup>, 2015 had recorded temperatures of a high of 56 degrees. The conditions did not get any more favorable during the post-test observations of the study. On Saturday, November 28<sup>th</sup> the weather was only recorded to have a high of 34 degrees. In addition to the colder temperatures, the location saw freezing rain during the time of the study. The weather for post-test the following day only saw a high of 38 degrees. A growing body of evidence shows that physical activity may in fact be hindered environmental influences. Extreme temperatures and precipitation levels may influence physical activity behaviors, especially walking outdoors (Tucker & Gilliland, 2007).



This would be apparent in this study where the physical activity must be achieved outdoors.

Due to the freezing rain, people may not have wanted to walk to their destination, but instead waited for the transportation due to the weather conditions. This was apparent in the observational study of the post-test. The shuttle came to pick-up people approximately every 15 minutes and when the shuttle came across the camera is many people would come on the view of the camera and get on the shuttle. In addition, other individuals avoided the elements by staying on the bottom level of the parking garage. In fact, the ensuing effect of poor or extreme weather has been documented as an obstacle to participate in physical activity across various populations (Tucker & Gilliland, 2007). This can be explained by referencing the health belief model. In this model, decision-makers make a mental calculation on whether making a behavioral change the physiological costs or obstacles that may perceive (Green & Murphy, 2014). It would be recommended to do this study in the beginning of the fall when the weather is more favorable for people to walk instead of taking public transportation to the game.

Another limitation to the study was the time of pre and post-test took place at the bus stop location. The video was recorded approximately two hours before the start of the home Oklahoma State football games, however, the time of the games were 7:00 PM and 7:30 PM, respectively. Due to the games being in the winter, the sun was setting during much of the time the video was being recorded. The low level of light made it challenging to accurately make observations of the people within the frame of the camera. The video at the community location had much more favorable lighting to

determine the physical characteristics and behavior of the people being observed since they were recorded in the afternoon.

Another implication of the study was the quality of camera that was used. In the study, a GoPro Hero 4 was used to record the video at both locations and was mounted in a car. Due to the length of size of the video, it was not possible to record the observations at the highest quality setting. If the study was replicated, it would be recommended to use another form of video recording device that allows a person to record at 1080P.

However, although the study did not produce the desired results the built environment still has lasting impact on the physical activity levels of the population. Land use characteristics in the built environment are significant when providing cues to action and opportunities for physical activity. For example, researchers have examined the relationship between the built environment in communities with people who cycle or walk for their mode of transportation. In 2002, a review showed that people are more likely to engage in walking or cycling for transportation if their neighborhoods have a higher residential density, grid-like connected streets, and a mixture of land uses (e.g. shops are within walking distances of their homes) (Brownson et al., 2005)

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## APPENDICES

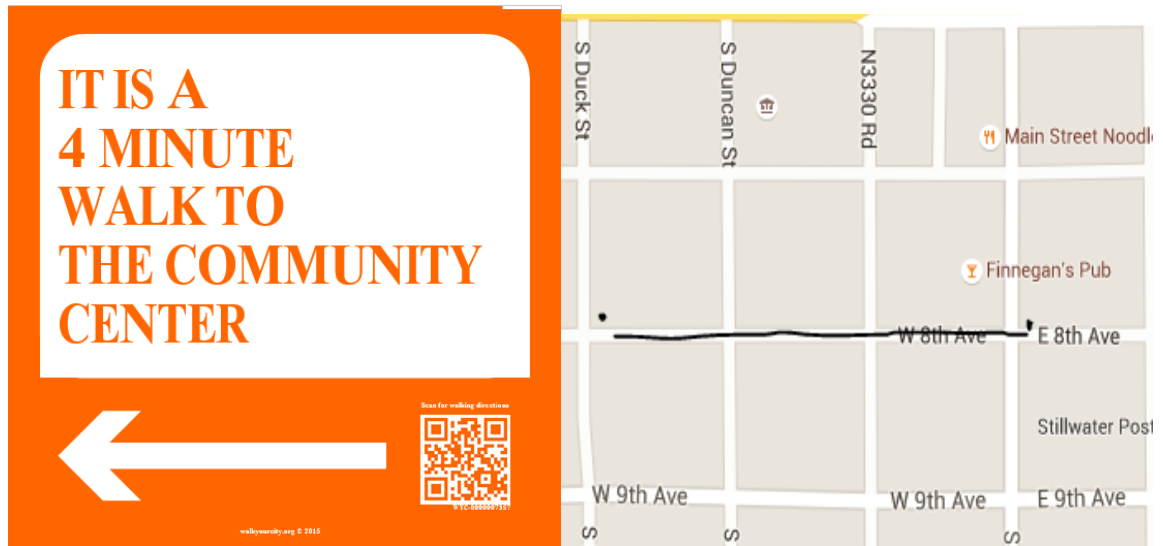
Although the results of the study were null, this project is positive for the community of Stillwater and provides guidance on how to replicate the study in the future. The study brought attention to the importance of the built environment for physical activity and created a community that promoted a healthy wellbeing. Creating the awareness has the ability to lead to substantial change. Stillwater, used valuable resources to install the signs. This shows their commitment to engage people within the community to increase their physical activity levels and their overall health. An attribute that other communities should mirror. In addition, Oklahoma State University investing in the cost of the signs shows their commitment to wellness. Investing in the built environment should not regress. It is hoped that this study will further the development of an environment that is supportive of increasing the physical activity levels. Using surveys may produce more desirable results as well. This could allow the participant to become aware of the sign potentially driving them toward behavior change.

In addition, the researcher would have access to additional insight on why people choose not to walk, barriers, and the benefits of choosing an active lifestyle over being sedentary. This could give valuable insight on how to improve the built environment in the community.

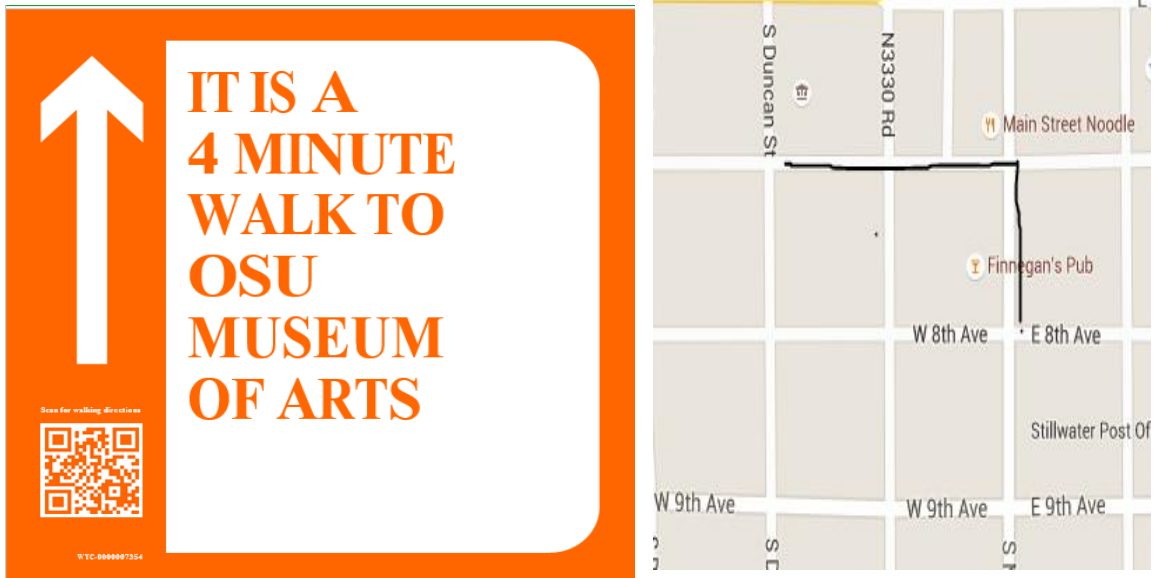
A comprehensive marketing campaign advocating the signage would have also been beneficial to raise awareness to the project. This marketing campaign could have included reaching out to local newspapers, radio station, news outlets, and business to talk about the signs. These outlets have access to



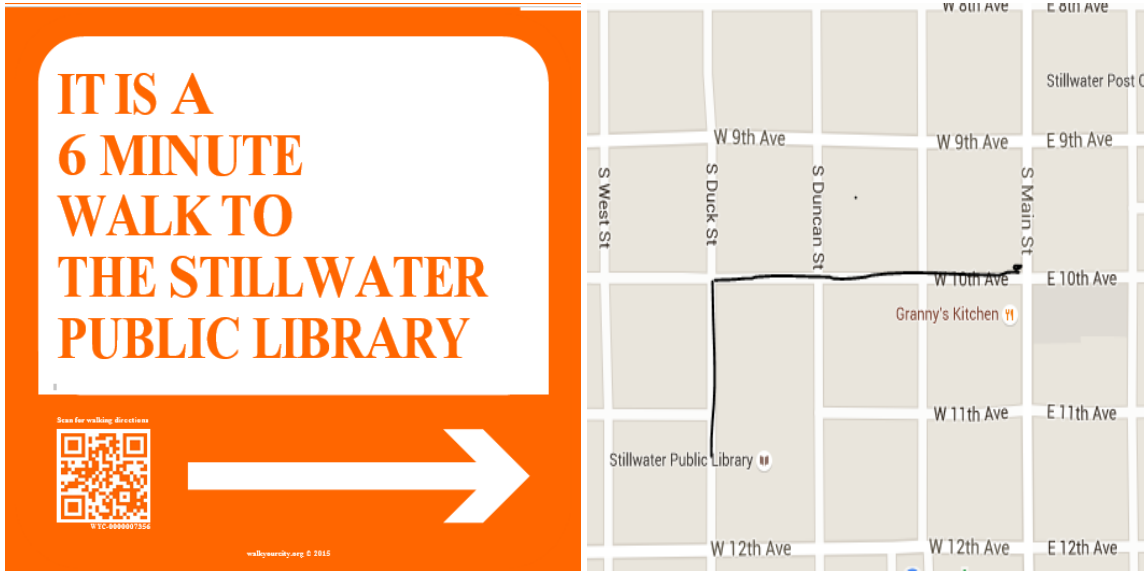
**Figure 6.1: The Sheerar Museum  
10<sup>th</sup> and Main – Downtown Stillwater**



**Figure 6.2: The Community Center  
8<sup>th</sup> and Main – Downtown Stillwater**



**Figure 6.3: OSU Museum of Arts  
8<sup>th</sup> and Main – Downtown Stillwater**



**Figure 6.4: The Stillwater Public Library  
10<sup>th</sup> and Main – Downtown Stillwater**

**IT IS A  
16 MINUTE  
BIKE RIDE TO  
DOWNTOWN  
STILLWATER**

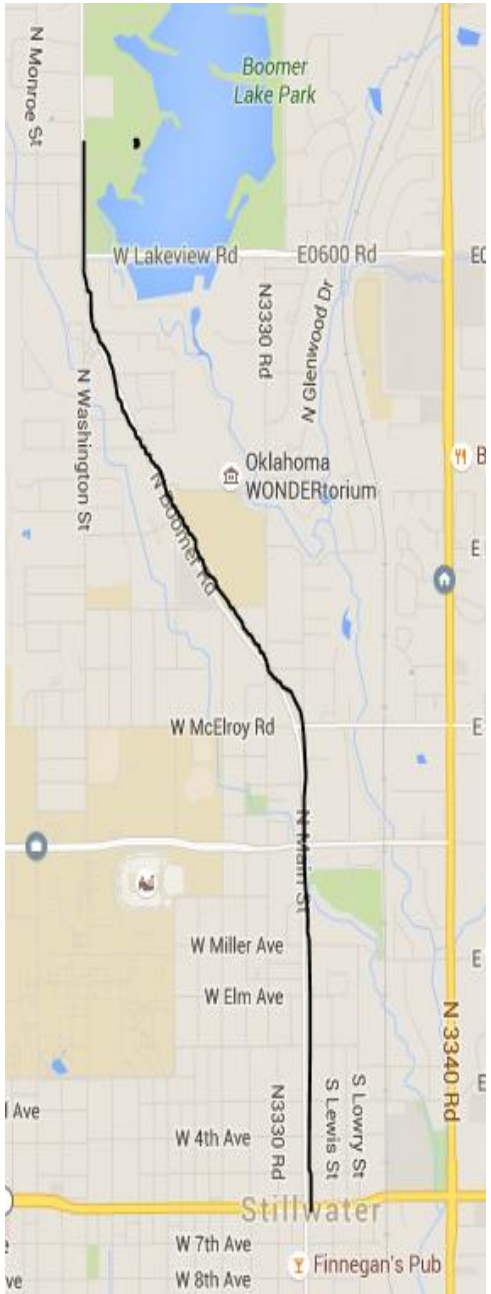
Scan for biking directions



WTC-0000001359



willywurd@yarp © 2015



**Figure 6.5: Downtown Stillwater  
Boomer Lake**

**IT IS A  
13 MINUTE  
BIKE RIDE TO  
BOOMER LAKE**

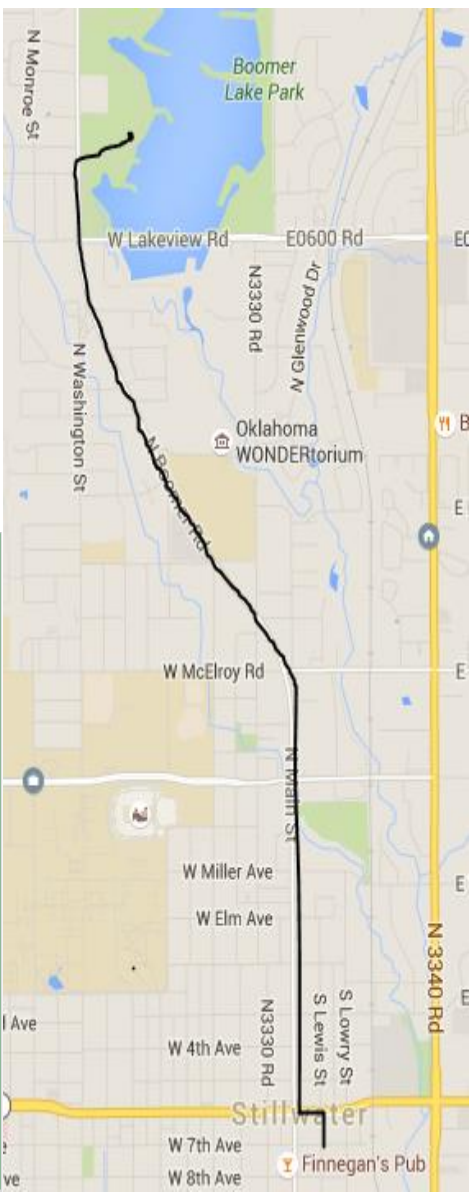


Scan for biking directions



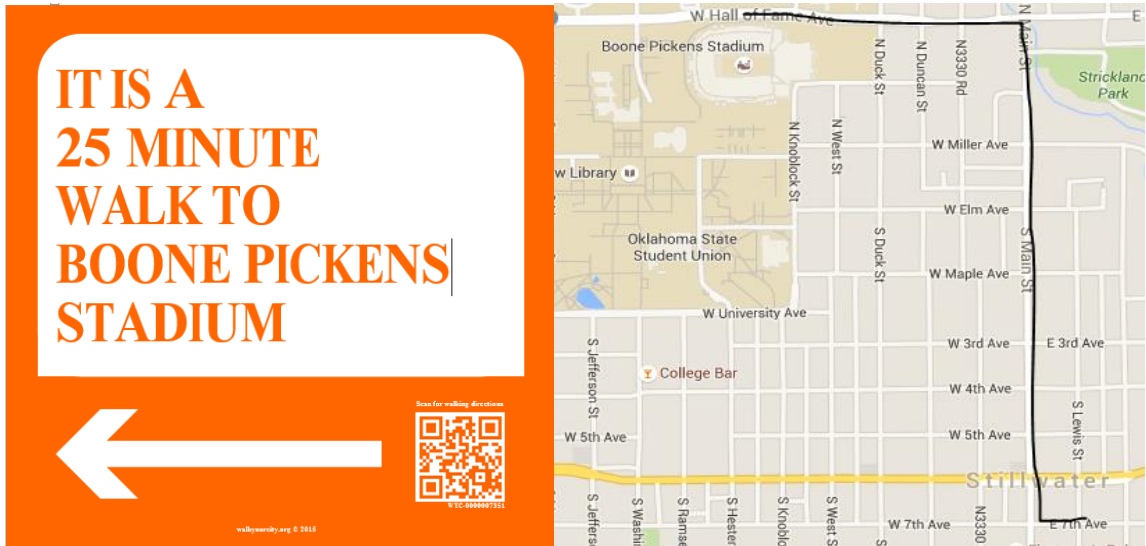
WTC-0000007308

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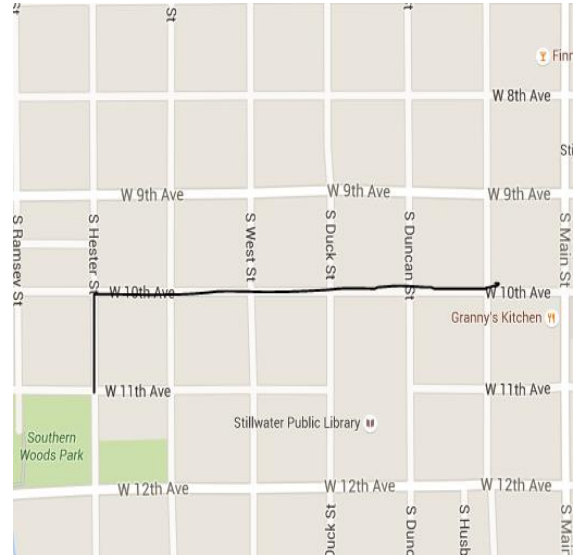


**Figure 6.6: Boomer Lake  
7<sup>th</sup> and Lewis – Downtown Stillwater**

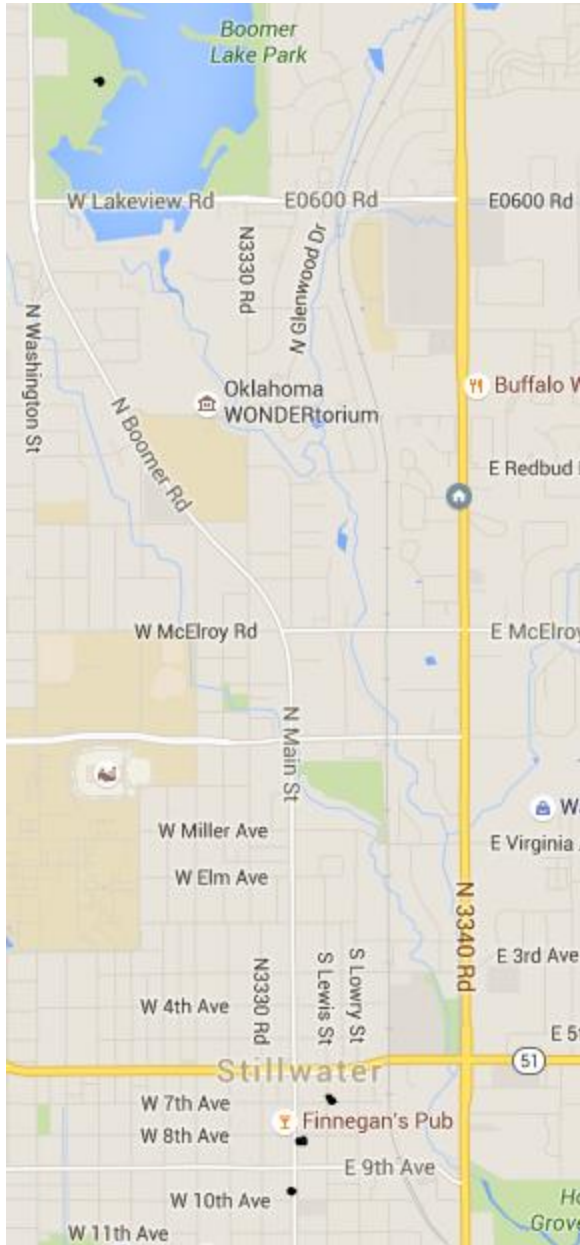




**Figure 6.7: Boone Pickens Stadium  
7<sup>th</sup> and Lewis – Downtown Stillwater**



**Figure 6.8: Southern Woods Park  
10<sup>th</sup> and Main – Downtown Stillwater**



**Figure 6.9: Sign Locations (black dot)**

Oklahoma State University Institutional Review Board

Date: Thursday, November 19, 2015  
IRB Application No GC1517  
Proposal Title: Walk Stillwater

Reviewed and Processed as: Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 11/18/2018

Principal Investigator(s):  
Preston Nesemeier Julie M. Croff  
429 Willard  
Stillwater, OK 74078 Stillwater, OK 74078

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The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2. Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of the research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Scott Hall (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,



Hugh Crethar, Chair  
Institutional Review Board

VITA

Preston Abel Nesemeier

Candidate for the Degree of

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INFLUENCE PHYSICAL ACTIVITY IN THE DOWNTOWN COMMUNITY

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Professional Memberships: NIRSA